[SPECIFICATION]

[TITLE OF THE INVENTION]

PANEL DISPLAY DEVICE USING HOLOGRAM PATTERN LIQUID CRYSTAL

[BRIEF DESCRIPTION OF THE DRAWINGS]

FIG. 1 illustrates a diagram showing an example of a related art liquid crystal device.

FIG. 2 illustrates a sectional view showing an example of a panel display device according to the present invention.

FIG. 3 illustrates a perspective view of a panel display device in FIG. 2.

FIG. 4a and 4b illustrates a first preferred embodiment of a method for connecting light source with waveguide according to the present invention.

FIG. 5a and 5b illustrates a second preferred embodiment of a method for connecting light source with waveguide according to the present invention.

FIG. 6a and 6b illustrates a third preferred embodiment of a method for connecting light source with waveguide according to the present invention.

FIG. 7a illustrates a diagram showing a structure of a hologram pattern liquid crystal according to the present invention.

FIG. 7b illustrates a diagram showing an example of forming a hologram pattern liquid crystal according to the present invention.

FIG. 8a illustrates a diagram for describing an operating principal of a case that voltage is not applied to a hologram pattern liquid crystal according to the present invention.

FIG. 8b illustrates a diagram for describing an operating principal of a case that voltage is applied to a hologram pattern liquid crystal according to the present invention.

FIG. 9 illustrates a diagram showing a method for driving a hologram pattern liquid crystal according to the present invention.

FIG. 10 illustrates a time diagram showing an example of embodying gradation of a hologram pattern liquid crystal according to the present invention.

FIG. 11a and 11b illustrates a diagram showing an example of displaying color of a hologram pattern liquid crystal according to the present invention.

Reference numerals of the essential parts in the drawings

21 : light source	22 : waveguide core
23 : waveguide cladding	24 : reflecting mirror
25 : first transparent electrode	
26 : liquid crystal	
27 : second transparent electrode	
111 : pixel	112 : R sub pixel
113 : G sub pixel	114 : B sub pixel

[DETAILED DESCRIPTION OF THE INVENTION]

[OBJECT OF THE INVENTION]

[FIELD OF THE INVENTION AND DISCUSSION OF THE RELATED ART]

The present invention relates to a panel display device, and more particularly, to a panel display device for adjusting color and quantity selectively by forming a hologram pattern on a liquid crystal.

In general, a panel display device is a flat type for implementing a thin, light and clear screen contrary to the conventional display device using CRT.

Such a panel display device is classified into a LCD, EL, PDP, and FED.

A LCD most generally used in the above panel display devices has a structure as shown in FIG. 1.

A light source (11) generates light by a power operating unit (191) getting a supply of electric power.

The generated light is incident to a light guide panel (12) and reflected in the light guide panel (12), and a direction of the incident light is changed to upward.

The light from the light guide panel (12) diverges from a diffusion plate (13) to having a uniform optical distribution factor, and the phase of the light is compensated for through a compensation plate (14), and then adjusted so as to be met to a polarization direction of a first polarization plate (151).

A light in a state of polarization of one direction passes through a liquid crystal (16) and a second polarization plate (172). In this instance, a polarization direction of the second polarization plate (172) is perpendicular to a polarization direction of the first polarization plate (151).

Herein, if a video signal is inputted, an image driving unit (192) applies a voltage to the first and second electrodes (152, 171) located on upper and lower parts of the liquid crystal (16). Then, the liquid crystal (16) reacts and a row direction is changed for adjusting the quantity of light passing through the liquid crystal, so that the image is displayed.

The image in which the quantity of light is adjusted by the liquid crystal passes a protecting plate (18), so that a user can watch it.

[TECHNICAL TASKS TO BE ACHIEVED BY THE INVENTION]

However, it has a limit that a LCD in FIG. 1 should use polarization plates (151, 172). So, it is hard to increase a brightness when using same light source, and extra components and filter has to be used. Further, a color filter should be used for embodying color image.

The present invention is directed to a panel display device that substantially obviates or more problems due to limitations and disadvantages of the related art.

An object of the present invention is to provide a panel display device not using polarization and removing additional filters.

[SYSTEM AND OPERATION OF THE INVENTION]

To achieve these objects and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, a panel display device using a hologram pattern liquid crystal according to the present invention comprises: a light source, a core that light from the light source is incident thereto, a optical waveguide formed on a part of outside of the core and made of cladding causing total reflection for light processed along the core; and a liquid crystal having a hologram pattern formed between the first and second transparent electrodes formed on the other surface of the optical waveguide for adjusting wavelength of the light transmitted through the optical waveguide and quantity of the transmitted light.

The light incident into the optical waveguide core is progressed along the optical wavelength in the optical waveguide core by total reflection phenomenon by difference of refractive index between the optical waveguide core and the optical waveguide cladding.

A reflecting mirror mounted on the other end surface of the optical waveguide and reflecting the light progressed along the optical waveguide in order for the reflected light

to be progressed along the optical waveguide toward opposite direction is further included.

The light source is located in a side area of the optical waveguide core for the illuminated light to be incident into the optical waveguide core. In this instance, an incident method of light becomes different depending on a kind of the light source and a type of the optical waveguide core.

The light source places a long light source illuminating one surface of the screen in a perpendicular direction, and the optical waveguide core illuminates whole pixels of the screen by spreading the incident light from the light source on the entire surface of the optical waveguide by using integral optical waveguide core.

The light source places a long light source illuminating one surface of the screen in a perpendicular direction, and the optical waveguide core places in a linear shape for corresponded to pixels comprising one column of the screen. The light incident from the light source illuminates pixels of corresponding column of the whole screen by progressing along the corresponding optical waveguide core.

The light source uses light source corresponding each column of the screen and the optical waveguide core is placed in a linear shape to be corresponded to pixels comprising one column of the screen. The light emitted from the light source is directly incident into the corresponding optical waveguide core, and the light incident into the corresponding optical

waveguide core is progressed along the corresponding optical waveguide core for illuminating pixels of the corresponding column of the whole screen.

Generally, the liquid crystal of the hologram pattern comprises liquid crystal molecules which form the hologram pattern and a monomer. The liquid crystal molecules and the monomer are periodically arranged and have a band shape. Also, the refraction index of the liquid crystal molecules and the refraction index of the monomer are different from each other to form a periodic refraction index lattice.

In the present invention, the gradation of the picture can be represented by adjusting the transmission factor of the liquid crystal by adjusting the level of the voltage of the respective pixels. Meanwhile, the quantity of light can be adjusted by adjusting the frequency of on/off operation of the respective pixels for a predetermined time.

When forming hologram patterns on the liquid crystal, sub-pixel is formed for each pixel by adjusting periodic lattice by changing diffraction components on each pixel and dividing into R, G, and B sub-pixels, respectively. The voltage is applied to R, G, and B sub-pixels of each pixel corresponding to image signal of the corresponding pixel in order to implement the color image of each pixel.

Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings. Wherever possible,

the same reference numbers will be used throughout the drawings to refer to the same or like parts.

FIG. 2 illustrates a sectional view showing a panel display device according to the present invention and FIG. 3 illustrates a perspective view of a panel display device according to the present invention.

A panel display device according to FIGS. 2 and 3 includes a light source (21), an optical waveguide core (22) progressed by incident light of the light source (21), an optical waveguide cladding (23) located an outer side of the optical waveguide core (22) for total reflecting of the light in the optical waveguide, a reflecting mirror (24) located on the end surface of the optical waveguide for reflecting the light, a first and second electrodes (25, 27) located on the optical waveguide for operating liquid crystal, and a liquid crystal (26) adjusting the quantity of light and wavelength by electrical signal between the first and second transparent electrodes (25, 27).

The light source is located in a side area of the optical waveguide core (22) in order for the light to be progressed toward the optical waveguide core (22) for the light to be incident into the optical waveguide core (22).

The light incident into the optical waveguide core is progressed along the optical wavelength in the optical waveguide core (22) by total reflection phenomenon by difference of refraction index between the optical waveguide

core (22) and the optical waveguide cladding (23).

That is, if refraction index of the optical waveguide core (22) is greater than that of the optical waveguide cladding (23), the light incident into the optical waveguide core (22) is progressed along the optical waveguide core (22) without getting out of the optical waveguide core (22) by total reflection phenomenon.

The light traveling along the optical waveguide is reflected by the reflective mirror (24) on the end surface of the optical waveguide, and then progressed in an opposite direction along the optical waveguide.

The light incident to the optical waveguide core (22) is dispersed at the last surface of the light waveguide corresponding to the last surface of the screen and goes and returns the optical waveguide by the reflecting mirror (24) without deteriorating the quality of screen or destroyed.

Since the incident light travels and returns along the optical waveguide, the light efficiency and the brightness of a picture can be increased.

The first and second transparent electrodes (25, 27) are located on an upper surface of the optical waveguide and a liquid crystal (26) is located therebetween. The liquid crystal (26) forms hologram pattern according to the predetermined method.

At this time, if voltage is applied to each pixel of the liquid crystal (26) by the first and second transparent

electrodes (25, 27) according to an image signal from outside, an image is displayed by adjusting the quantity of light and wavelength corresponding to the image signal as transmissibility of the liquid crystal (26) is changed. More specifically, the first and second transparent electrode (25, 27) applies voltage to the liquid crystal according to the image signal from outside corresponding to each pixel of the liquid crystal in order to implement image by adjusting penetrating light quantity of the liquid crystal.

Meanwhile, there are many ways to make the light incident to the optical waveguide core (22) of the optical waveguide in accordance with the kind of the light source (21) and the shape of the core (22) of the optical waveguide.

FIGS. 4a to 4b are views illustrating examples of cases of using long light source illuminating one surface of the screen as a light source and using an integral optical waveguide.

More specifically, a light source (41) is placed in a length direction and a reflecting mirror (42) is placed at the outside for collecting light dispersed from the light source (41) for progressing in a direction of the optical waveguide core (43) to incident light into the optical waveguide core (43).

The light incident to the optical waveguide propagates through the whole face of the optical waveguide and illuminates the whole pixels of the screen.

At this time, the light source (41) comprise a bar type fluorescent lamp.

FIGS. 5a to 5b are views illustrating examples of cases of using long light source illuminating one surface of the screen as a light source and using a linear optical waveguide.

More specifically, a light source (51) is placed in a length direction and a reflecting mirror (52) is placed at the outside for collecting light dispersed from the light source (51) for progressing in a direction of the optical waveguide core (53). The optical waveguide core (53) is placed in a linear type in order to be corresponded to pixels comprising one column of the screen. For example, in the case of a resolution of XGA (1024×768), the optical waveguide 20 should have 1024 or 768 cores so as to correspond to the pixels in a column direction.

The light incident to the optical waveguide core (53) of each column illuminates pixels of the corresponding column of the whole screen by progressing the corresponding optical waveguide.

FIGS. 6a to 6b are views illustrating examples of cases of using light source corresponding to each column of the image as a light source and using a linear optical waveguide.

That is, the light source (61) is arranged so as to correspond to the optical waveguide comprising one column of the image.

The light emitted from the light source (62) is directly incident to the corresponding optical waveguide core (62). The light incident to the corresponding optical waveguide core (62) progresses the optical waveguide and implements pixels of the corresponding column in order to display the screen.

The white LED, the combination of RGB LED, and the combination of RGB LD can be used as the light source (61).

Meanwhile, the liquid crystal (26) forms hologram pattern by the predetermined method, and FIGS. 7 and 8 illustrates an operating principle of the hologram pattern liquid crystal.

Generally, the liquid crystal of the hologram pattern, as shown in FIG. 7a, comprises liquid crystal molecules (73) which form the hologram pattern between the first and second transparent electrodes (71, 72), and a monomer (73).

The liquid crystal molecules (72) and the monomer (73) are periodically arranged and have a band shape.

Also, the refraction index of the liquid crystal molecules and the refraction index of the monomer are different from each other to form a periodic refraction index lattice.

The hologram pattern liquid crystal constructed as above is formed as follows. As shown in FIG. 7b, a laser reference light (78) and the laser light (76) are irradiated into a mixed liquid (75) of liquid crystal and monomer. At

this time, in the mixed liquid (75) of liquid crystal and monomer, a band-shaped interference pattern is formed due to the phase difference between the two laser lights, and this is called a hologram pattern (79). Here, the thickness, period, etc., of the hologram pattern (79) can be adjusted by means of a diffractive element (77). The diffractive element (77) may be a pattern made by a lens or a computer.

In the band-shaped hologram pattern (79), the monomer in a bright area of the mixed liquid (75) of the liquid crystal is polymerized by the light, and simultaneously the liquid crystal in the bright area is swept into a dark area. The hologram pattern has an arrangement in which a bright polymer area and a dark liquid crystal area are periodically alternated due to the irradiation of the laser light, and forms a periodic refraction index lattice.

FIG. 8 illustrates an operating principle of the hologram pattern of liquid crystal.

If a voltage is not applied to the hologram pattern liquid crystal as shown in FIG. 8a, the incident light (81) is diffracted by the refraction index lattice. That is, the incident light (81) is diffracted by the Bragg phenomenon appearing in the lattice having a constant period.

If the voltage is not applied to the hologram pattern liquid crystal, the liquid crystal molecules (85) are arranged irregularly, the incident light cannot permeate the liquid

crystal molecules, and the difference between the refraction index of the liquid crystal and the refraction index of the monomer is maintained. Accordingly, the hologram pattern liquid crystal has the refraction index having a constant period, and the incident light is diffracted. As shown in FIG. 8b, if the voltage is applied to the hologram pattern liquid crystal, the incident light (81) permeates the hologram pattern liquid crystal.

At this time, regularity of the arrangement of the liquid crystal molecules is changed corresponding to the volume of voltage applied to the liquid crystal, the quantity of light penetrating the liquid crystal is adjusted by adjusting the applied voltage.

Meanwhile, the light diffracted by refractive index lattice of the hologram pattern liquid crystal is connected to the period and distance of the lattice, so the light of desired wavelength can selectively be adjusted by adjusting the period and distance of the lattice.

Accordingly, the penetrating quantity of light and the wavelength corresponding to the color of light in hologram pattern liquid crystal can be adjusted.

Meanwhile, first and second transparent electrodes (25, 27) are placed on both sides of the hologram pattern liquid crystal in order to apply voltage corresponding image signal in a location of the corresponding pixels.

As shown in FIG. 9, transparent electrode is arranged in a signal line shape on upper/lower parts of the liquid crystal (93). The signal line is comprised of horizontal signal line (91) and the vertical signal line (92), and the point of crossing two signal lines corresponds to pixel (94).

If image signal of outside is inputted, an image signal controller (95) transmits signal to the horizontal and vertical signal lines (91, 92) in order to apply voltage of the corresponding image signal to each pixel.

Then, image of the corresponding image signal is implemented by voltage applied to each pixel.

As mentioned above, one surface of the optical waveguide core (22) is comprised of the optical waveguide cladding (23), and the other surface is comprised of transparent electrodes (25, 27) and a hologram pattern liquid crystal (26).

If voltage is applied to liquid crystal (26) of the hologram pattern, refractive index lattice is disappeared and has regular refractive index since the liquid crystal molecular of the corresponding pixel is arranged in a regular direction. If the corresponding refraction index is same as the refraction index of the cladding (23), the upper/lower parts of the optical waveguide core (22) plays a role of the optical waveguide cladding having the same refraction index, so that the light progresses in the optical waveguide core (22).

Accordingly, the corresponding pixels cannot transmit the light, and thus implement a black picture.

If the voltage is not applied to the liquid crystal (26) having the hologram pattern of the corresponding pixels, the liquid crystal molecules are arranged irregularly as shown in FIG. 8a. At this time, since the refraction index of the liquid crystal is different from the refraction index of the cladding, the light traveling through the core (22) of the optical waveguide permeate the liquid crystal.

Accordingly, the corresponding pixels transmit the light, and thus implement a white picture.

If voltage is applied to the hologram liquid crystal which is on-state, a black screen is implemented, and if voltage is not applied which is off-state, a white screen is implemented.

The gradation of the picture can be represented by adjusting the quantity of light. The gradation can be represented by adjusting permeability of the liquid crystal by adjusting the level of the voltage of the respective pixels.

Further, the quantity of light can be adjusted by adjusting the frequency of on/off operation of the respective pixels for a predetermined time. Specifically, the display system according to the present invention adopts 256 gradations, and applies 'on' signal to the respective pixel as many times as the gradations of the respective pixel for 60Hz.

For example, if one pixel represents 10 gradations, the 'on' signal is applied to the pixel 10 times for 1/60sec.

The gradation can be implemented in an analog form by means of the level of the applied voltage and in a digital form by means of the frequency of applying the voltage.

That is, the present invention can adjust the transmission factor of the liquid crystal by the level of the applied voltage, and can adjust the quantity of light by the frequency of applying the voltage.

In order to implement color image by hologram pattern liquid crystal, each pixel forms sub pixel and divides into R, G, and B pixel, respectively. It can be implemented by adjusting lattice period by changing diffraction elements to each pixel when forming hologram pattern.

As shown in FIG. 11, color picture is implemented by applying voltage to R, G, and B sub pixel of each pixel corresponding picture signal of the corresponding pixel and display the whole screen.

FIG. 11B shows the sub-pixels of each color arranged to cross each other in order to prevent the respective sub-pixels from being separately seen due to a large gap among the sub-pixels.

[EFFECT OF THE INVENTION]

As has been described, a panel display device using a hologram pattern liquid crystal according to the present

invention has following advantages.

First, since the present invention does not use the polarization plates and so on, the loss of light is reduced, and the brightness of the picture can be increased by effectively controlling the light.

Second, since the present invention does not require the additional filter comprising the panel display device, the manufacturing process is simplified, and a super-thin display system can be implemented.

Third, since the light in the optical waveguide path is reused, the use efficiency of the light can be heightened.

Fourth, since LED, LD, and so on, is used as a light source, the range of color representation is widened, thereby implementing a display device having clear picture quality.

It will be apparent to those skilled in the art than various modifications and variations can be made in the present invention. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.